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14. ABSTRACT

The long-term goal of this program is to be able to utilize SAR imagery to estimate surface currents over the ocean. With the availability of a large number of commercial SAR satellite sensors, it may be possible to have an operational capability to generate surface current maps around the world’s oceans that could be complimentary to the operational altimeters.

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Estimating Surface Currents from SAR

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LONG-TERM GOALS

The long-term goal of this program is to be able to utilize SAR imagery to estimate surface currents over the ocean. With the availability of a large number of commercial SAR satellite sensors, it may be possible to have an operational capability to generate surface current maps around the world's oceans that could be complimentary to the operational altimeters.

OBJECTIVES

There are two objectives in this program.

(1) Develop a capability to use SAR imagery to estimate surface currents.

(2) Develop a capability to assimilate the SAR estimates into current models and/or other observations to generate a wide-area surface current estimate

APPROACH

(1) Estimating surface currents from SAR

Two approaches will be investigated under this program. One will be the inversion of radar cross section (RCS) modulations into the underlying surface current gradient that has caused those modulations. This will be done by inverting the wave action balance equation that determines changes in wave spectra due to interaction with surface currents. This capability has been generated for internal wave signatures by another ONR program (the Non-Linear Internal Wave Initiative). Under this program, it will be modified for larger-scale current patterns. The second approach will be to generate a two-dimensional map of surface wave spectra from the SAR, and use the spatial changes in the spectra to estimate surface currents. We have already developed tools to estimate wave spectra under a NOAA/NESDIS program, however that algorithm will be modified under this program to include non-linear transfer functions. We anticipate that the translation of wave spectral changes into surface currents will also be done via inversion of the wave action balance equation

(2) Assimilation into current models

It is not clear if SAR imagery will ever be able to provide the wide-area view of surface currents required by operational users. Thus we anticipate that we may need to assimilate the SAR-derived currents into a large field-of-view by using existing models of current fields. We propose using the DELFT3D model for which we have done previous inversion work. We will modify this previous work so that we can determine the model inputs required to reproduce the SAR-derived currents, then use the model to generate the large field-of-view.

WORK COMPLETED

We are only in the initial stages of the work so far. We have started work on developing the adjoint expressions needed to invert the surface current that generated the radar cross section values via the wave action balance equation. We have previously done this in the NLIWI program using an assumed functional form for the surface current field (in that case a sech**2), but here we need a more general approach. The issue we are having is in making sure the derivatives of the current fields (which the radar cross section values are very sensitive to) are smooth. Work has only been completed so far on some initial derivations and simulation tests.

RESULTS

No significant results have been generated so far.

IMPACT/APPLICATIONS

If successful, the resulting algorithms will generate an operational capability to estimate surface currents from commercial SAR systems.

RELATED PROJECTS

The proposed research will start with algorithms for inverting the wave action balance equation to estimate currents that have been developed under the ONR Non-Linear Internal Wave Initiative. The proposed research will also start with algorithms for assimilating currents into DELFT3D that were developed under a previous ONR program entitled "DELFT3D Assimilation".